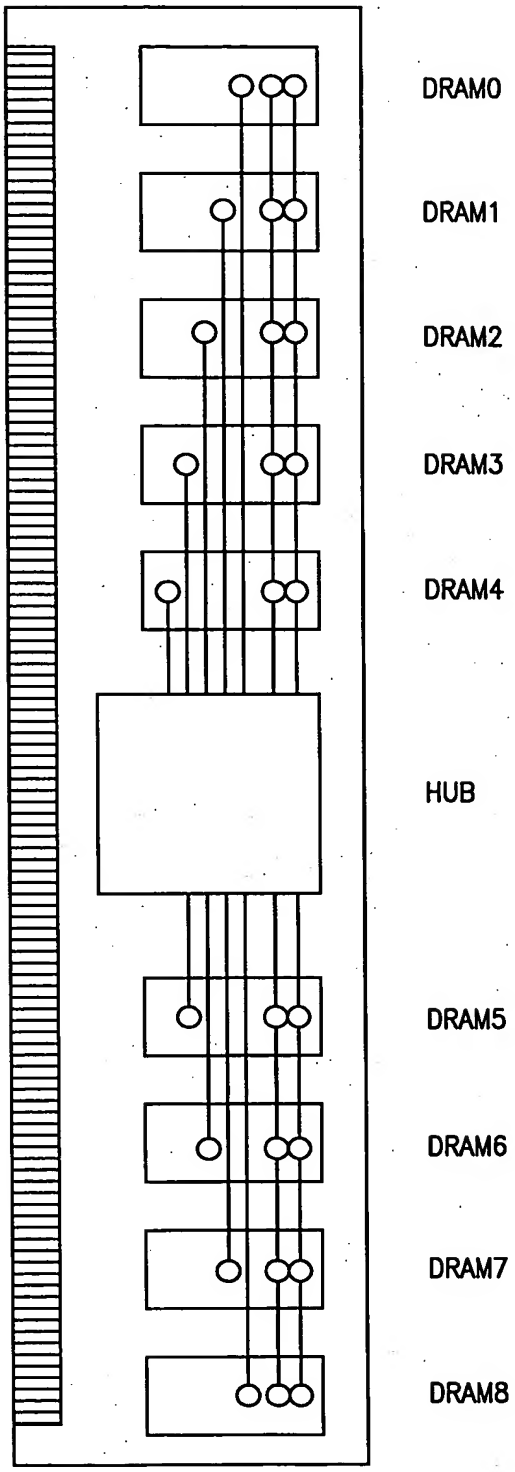


FIG. 1

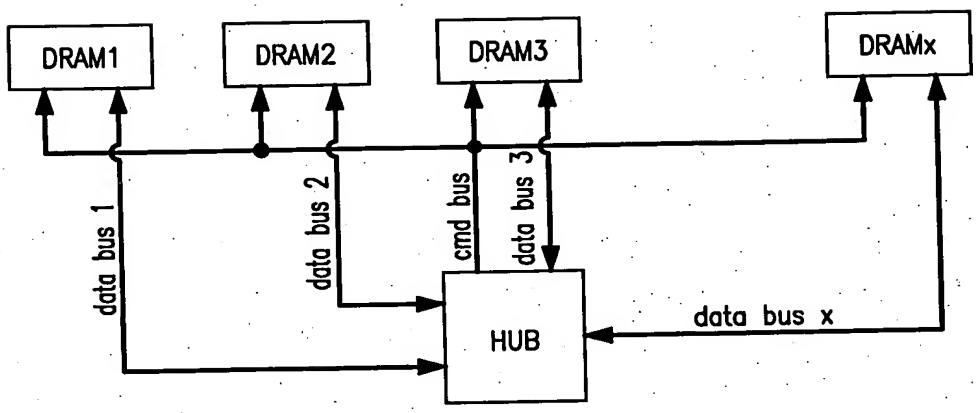

DRAM1
DRAM2
DRAM3
DRAMx
data bus 1
data bus 2
cmd bus
data bus 3
HUB
data bus x

FIG. 2

Title: METHOD FOR MEASURING AND COMPENSATING SKEWS OF DATA TRANSMISSION LINE
Applicant: Paul Georg Lindt
Serial No.: 10/808,145
Atty Docket: 1406/142/2

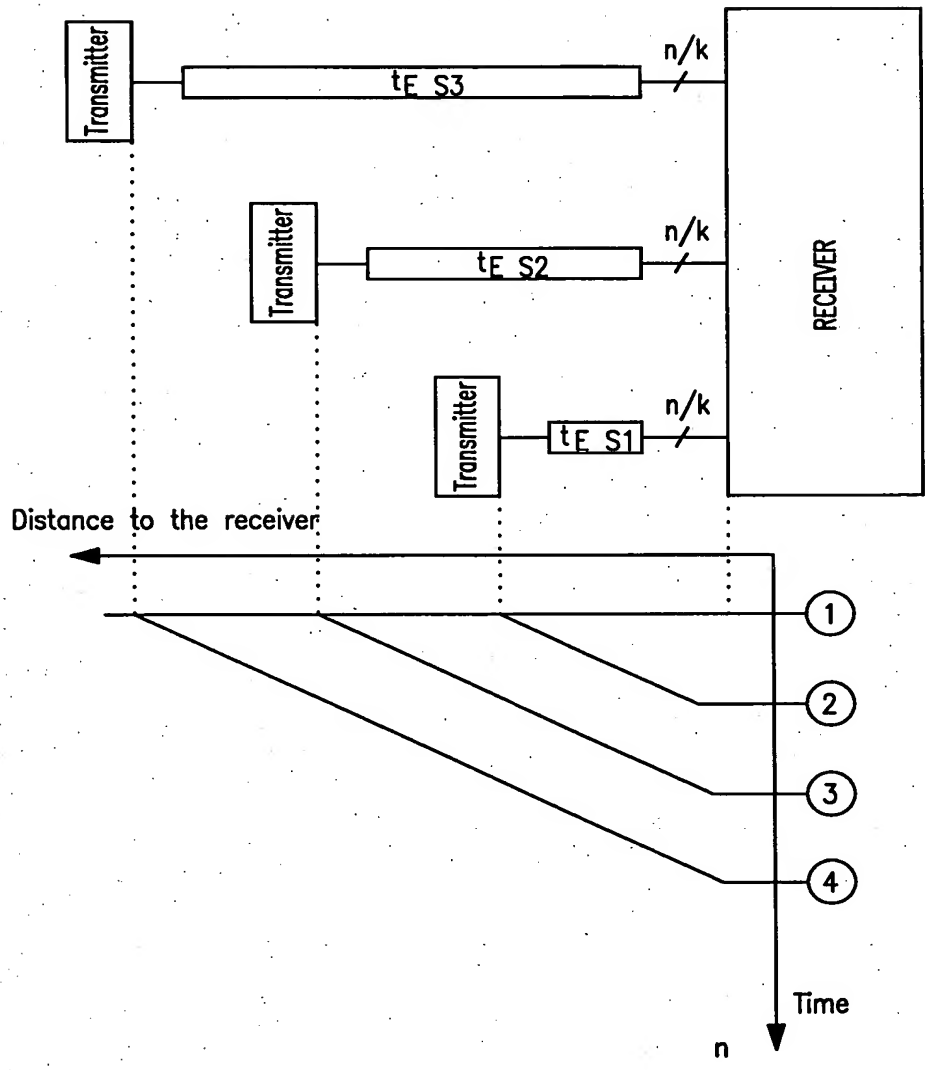
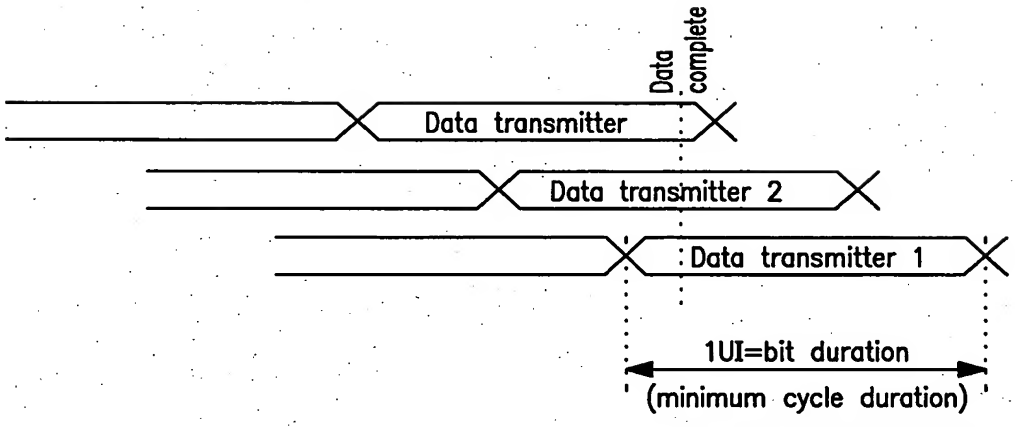


FIG. 3



Danger to data integrity resulting from delay time differences

FIG. 4

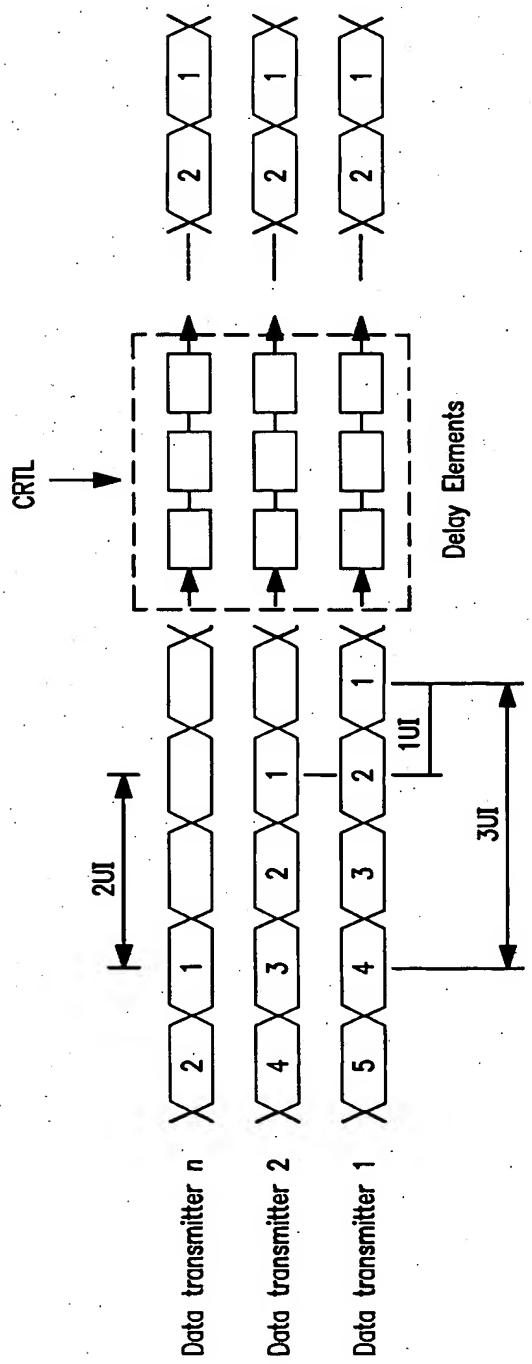

CRTL
Delay Elements
2UI
1UI
3UI
Data transmitter n
Data transmitter 2
Data transmitter 1

FIG. 5

Title: METHOD FOR MEASURING AND COMPENSATING SKEWS OF DATA TRANSMISSION LINE
Applicant: Paul Georg Lindt
Serial No.: 10/808,145
Atty Docket: 1406/142/2

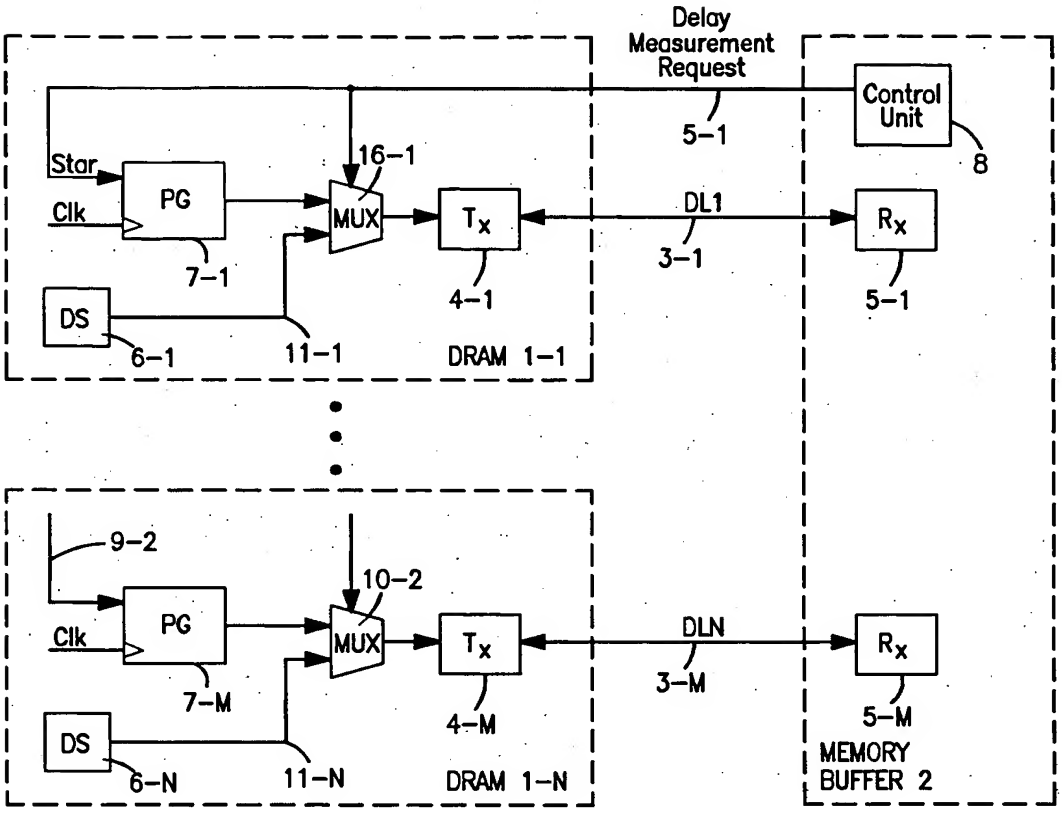


FIG. 6

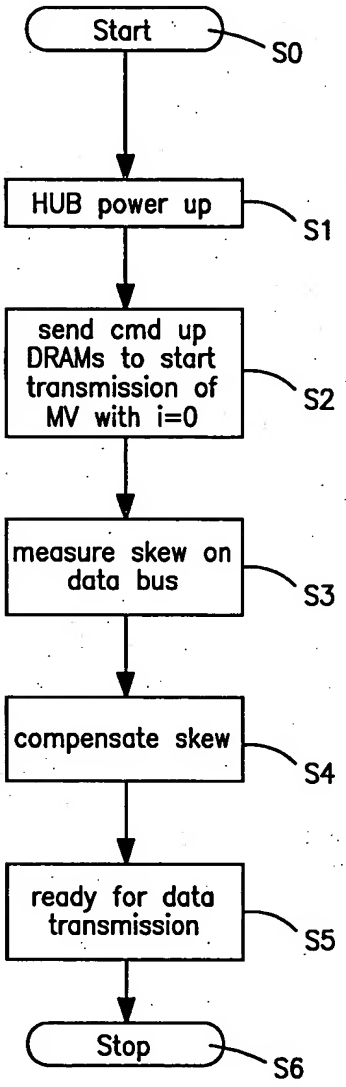

Start
S0
HUB power up
S1
send cmd up DRAMs to start transmission of MV with i=0
S2
measure skew on data bus
S3
compensate skew
S4
ready for data transmission
S5
Stop
S6

FIG. 7

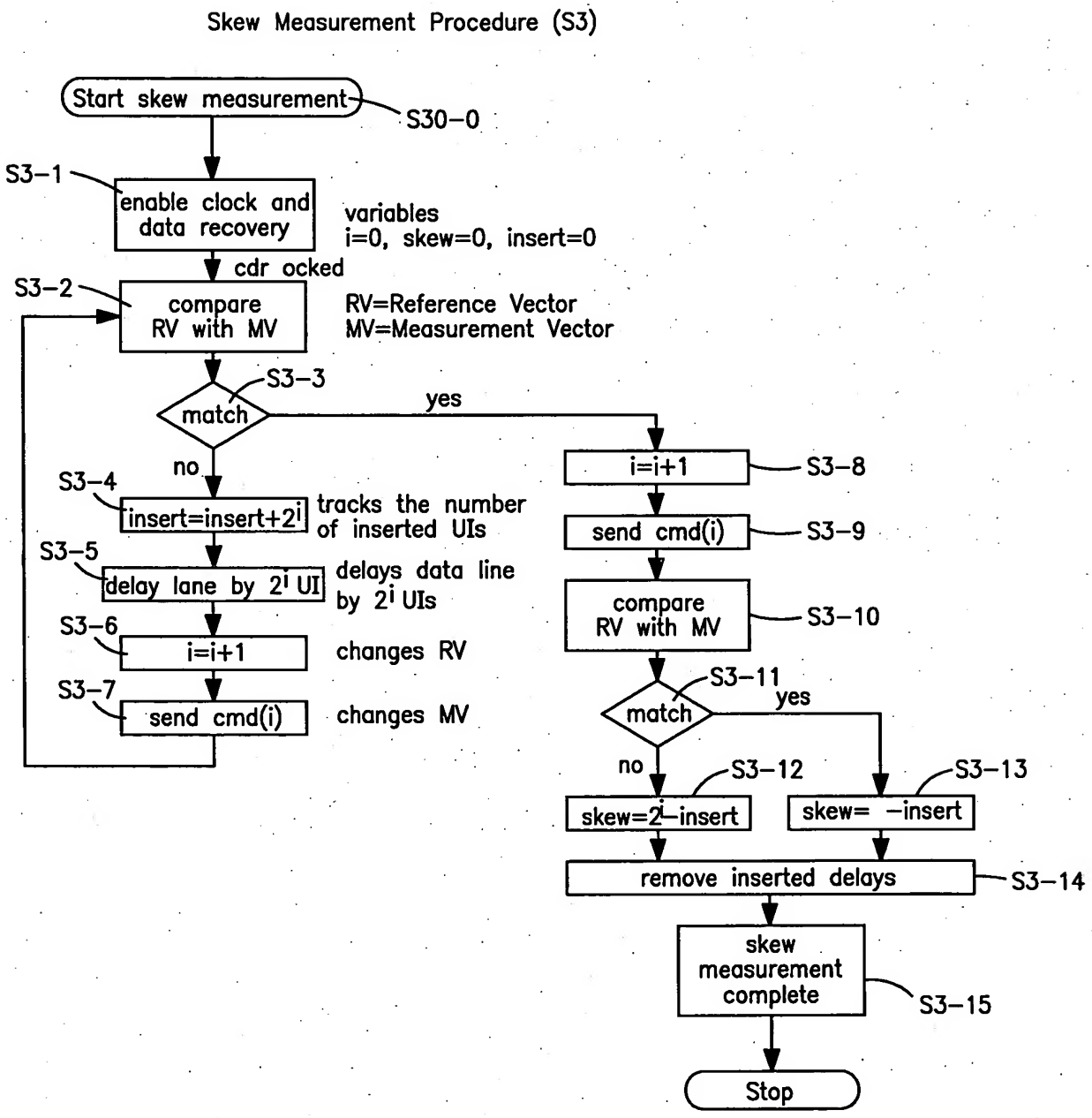

Skew Measurement Procedure (S3)
Start skew measurement
S30-0
S3-1
enable clock and data recovery
variables i=0, skew=0, insert=0
cdr ocked
S3-2
compare RV with MV
RV=Reference Vector
MV=Measurement Vector
S3-3
match
yes
no
S3-4
insert=insert+2^i
tracks the number of inserted UIs
S3-5
delay lane by 2^i UI
delays data line by 2^i UIs
S3-6
i=i+1
changes RV
S3-7
send cmd(i)
changes MV
i=i+1
S3-8
send cmd(i)
S3-9
compare RV with MV
S3-10
S3-11
match
yes
no
S3-12
skew=2^i-insert
S3-13
skew= -insert
remove inserted delays
S3-14
skew measurement complete
S3-15
Stop

FIG. 8

+3UI

i=0

RV 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0
MV 0 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1

cmp result 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 static "1" identifies negative match

→ 2^0 UI skew identified.
Insert = 1

FIG. 9a

i=1

RV 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0
MV 0 0 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 0 1

cmp result 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 static "0" identifies positive match

→ exit condition from loop

FIG. 9b

i=2

RV 1 1 1 1 0 0 0 0 1 1 1 1 0 0 0 0 1 1
MV 0 0 0 0 1 1 1 1 0 0 0 0 1 1

cmp result 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 static "1" identifies negative match

→ positive skew identified, i.e.
skew = 2^2 − insert = +3UI

FIG. 9c

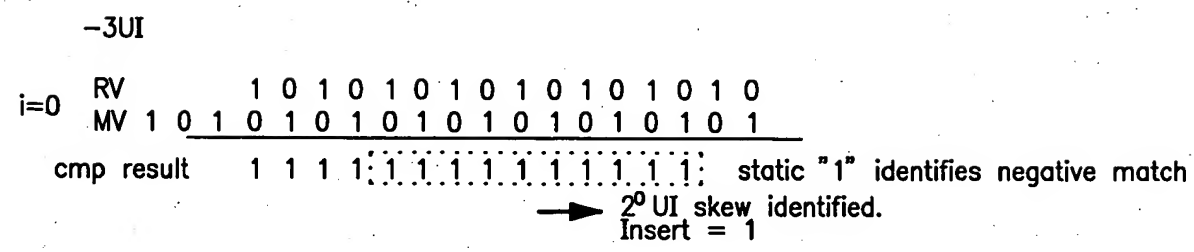


FIG. 10a

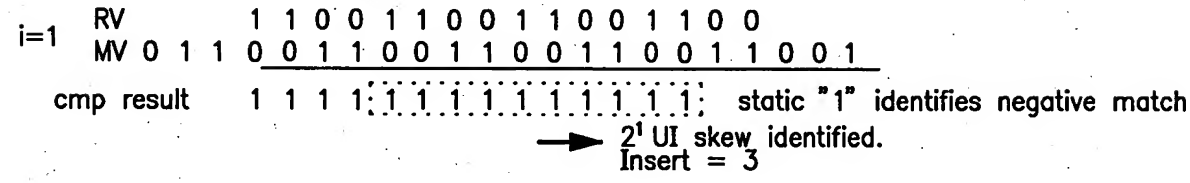


FIG. 10b

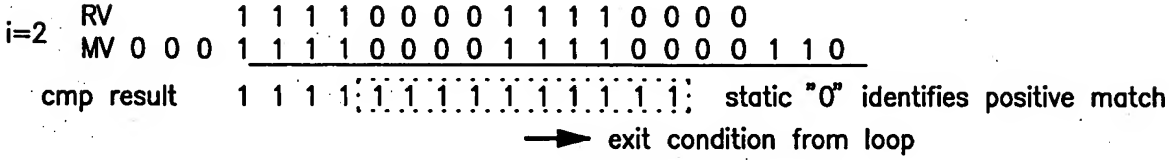


FIG. 10c

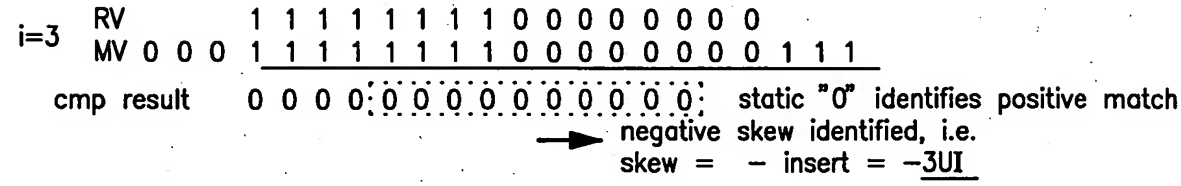


FIG. 10d

Skew Compensation Procedure (Step S4)

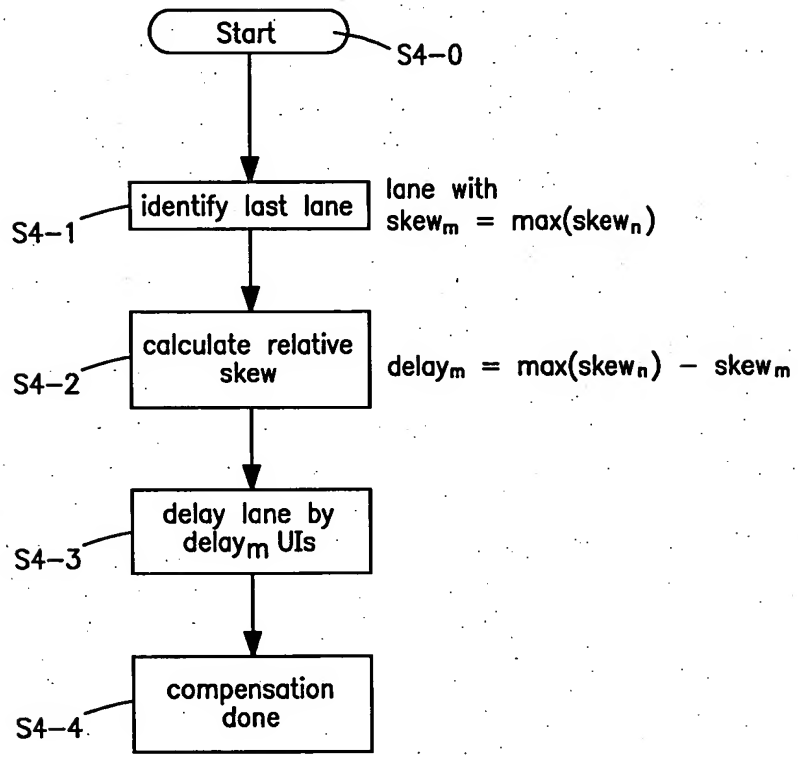


FIG. 11